Development of a new RF coil and gamma-ray radiation shielding assembly for improved MR image quality in SPECT/MRI.

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Public Summary:
Magnetic resonance (MR)-based multimodality imaging systems, such as single-photon emission tomography (SPECT)/magnetic resonance imaging (MRI) or positron emission tomography (PET)/MRI, face many difficulties because of problems with the compatibility of the nuclear detector system with the MR system. However, several studies have reported on the design considerations of MR-compatible nuclear detectors for combined SPECT/MRI. In this study, we developed a new radiofrequency (RF) coil and gamma-ray radiation shielding assembly to advance the practical implementation of SPECT/MRI in providing high sensitivity while minimizing the interference between the MRI and SPECT systems. The proposed assembly consists of a three-channel receive-only RF coil and gamma-ray radiation shields made of a specialized lead composite powder designed to reduce conductivity and thus minimizing any effect on the magnetic field arising from the induced eddy currents. A conventional birdcage RF coil was also tested for comparison with the proposed RF coil. Quality (Q)-factors were measured using both RF coils without any shielding, with solid lead shielding, and with our composite lead shielding. Signal-to-noise ratios (SNRs) were calculated using 4 T MR images of phantoms both with and without the new gamma-ray radiation shields. The Q-factor and SNR measurements demonstrate the improved MRI performance due to the new RF coil/gamma-ray radiation shield assembly designed for SPECT/MRI, making it a useful addition to multimodality imaging technology not only for animal studies but also for in vivo study of humans.

Scientific Abstract:
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